Research Results to Keep You Out of Trouble

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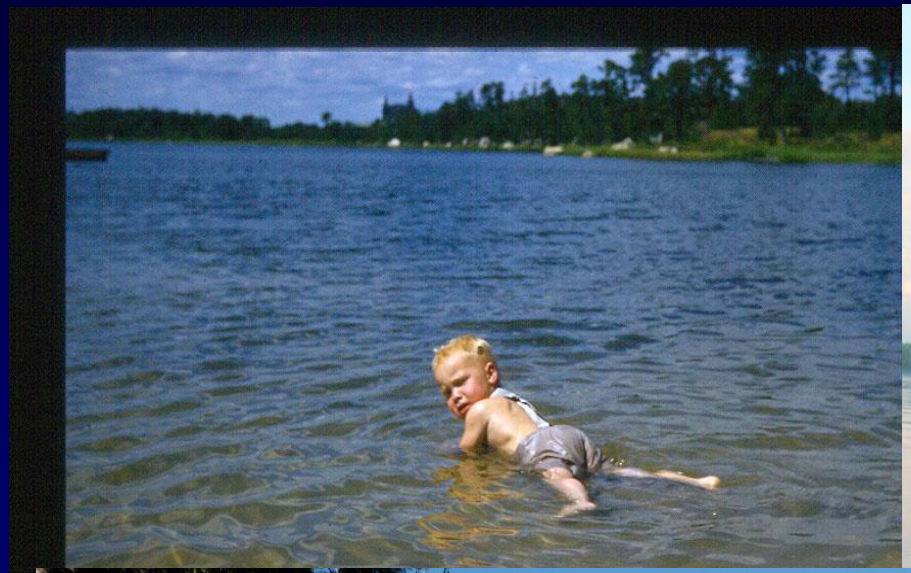
Water Quality is Important



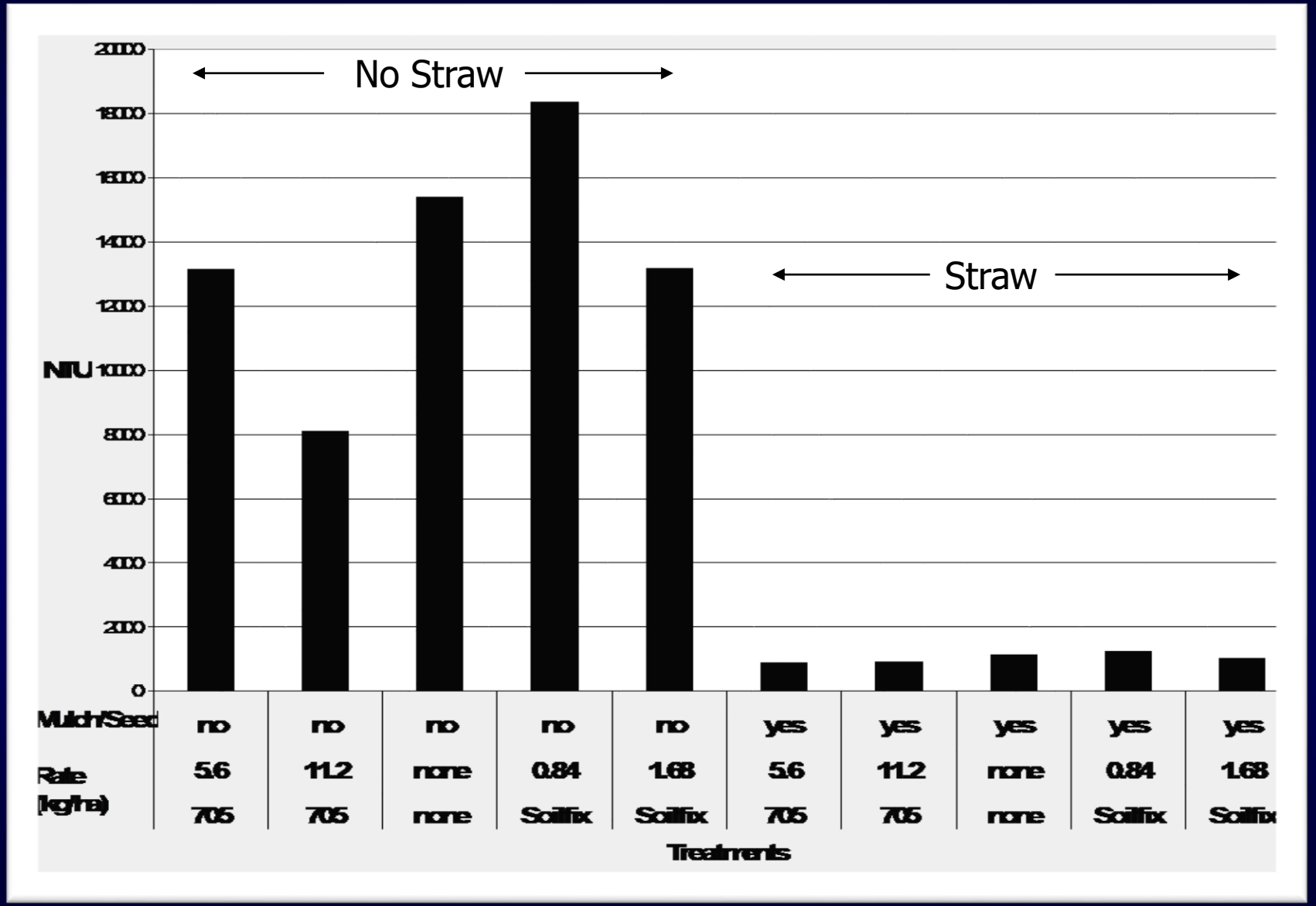
Three Key Areas

- Erosion: Keeping soil in place, vegetation establishment
- Sediment: Keeping sediment on site
- Turbidity: Reducing impacts of runoff on surface waters

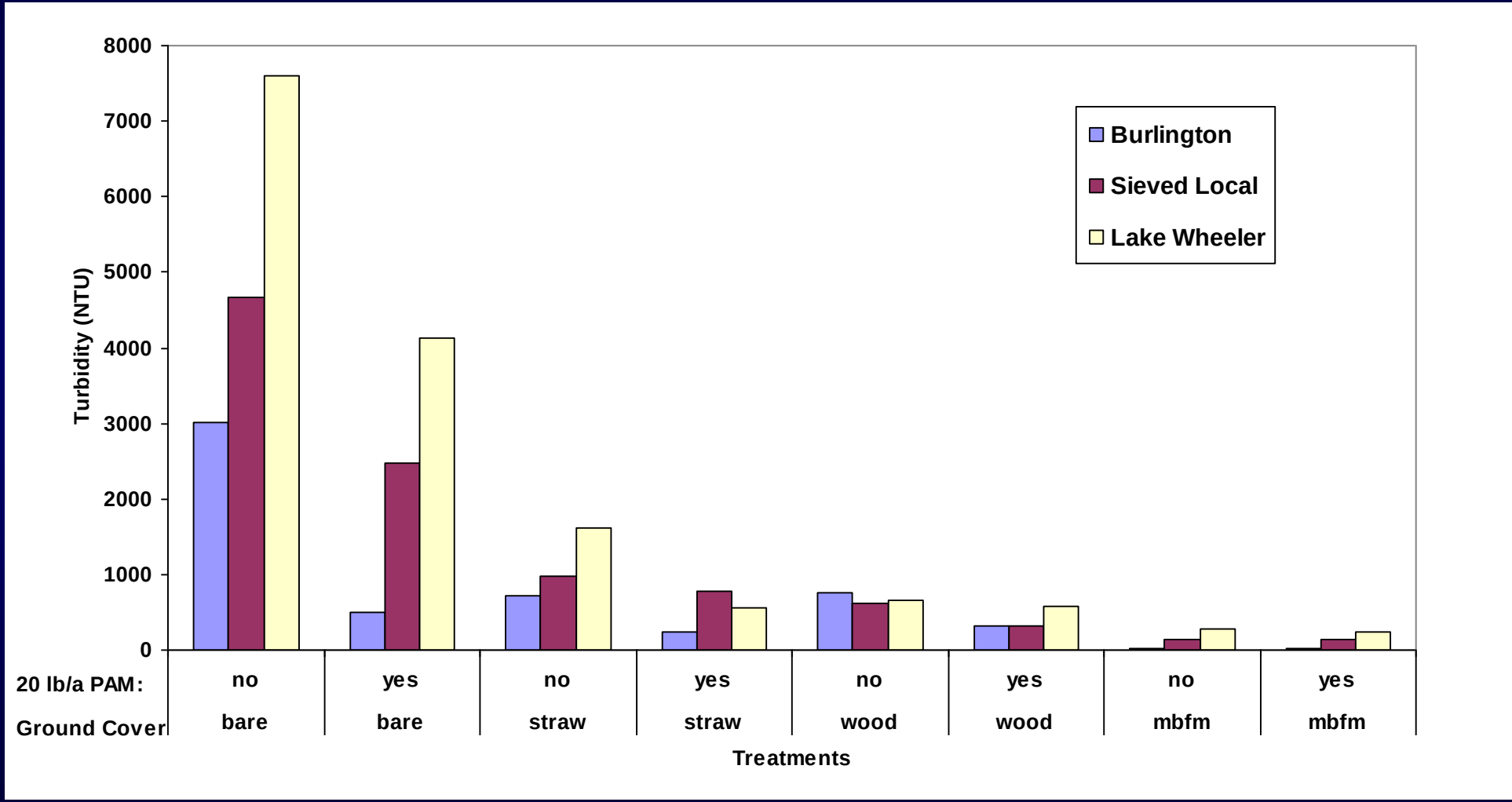
Ground Covers: Construction Site, Field, and Rainfall Simulator Testing

Controlling Erosion: Can Polyacrylamide Help?

Results: Need ground cover, more PAM



Rainfall Simulator: PAM (20 lb/acre) Reduces Turbidity for Most Groundcovers



More Mulch/PAM Tests

PAM Effects by Cover: Usually Large Turbidity Reduction

Cover	Sites	Erosion Rate Reduction
Straw	3	45-78%
Excelsior	2	51-69%
Wood Hydro	1	98%
Flexterra	1	20%

Straw vs Straw+PAM vs Hydromulches (5)

Final Results: Erosion

Treatment	Site 1, Kinston	Site 2, West Jefferson	Site 3, Garner	Site 4, Apex	Site 5, Holly Springs
			Total sediment loss (kg ha^{-1})		
Straw			3,685a	51bc	36b
Straw+PAM			1,261ab	29c	29b
SMM			959bc	N/A	35b
BFM			1,930ab	N/A	N/A
FGM			333c	164ab	N/A
WFM			N/A	237a	120ab
WCB			N/A	221ab	210a

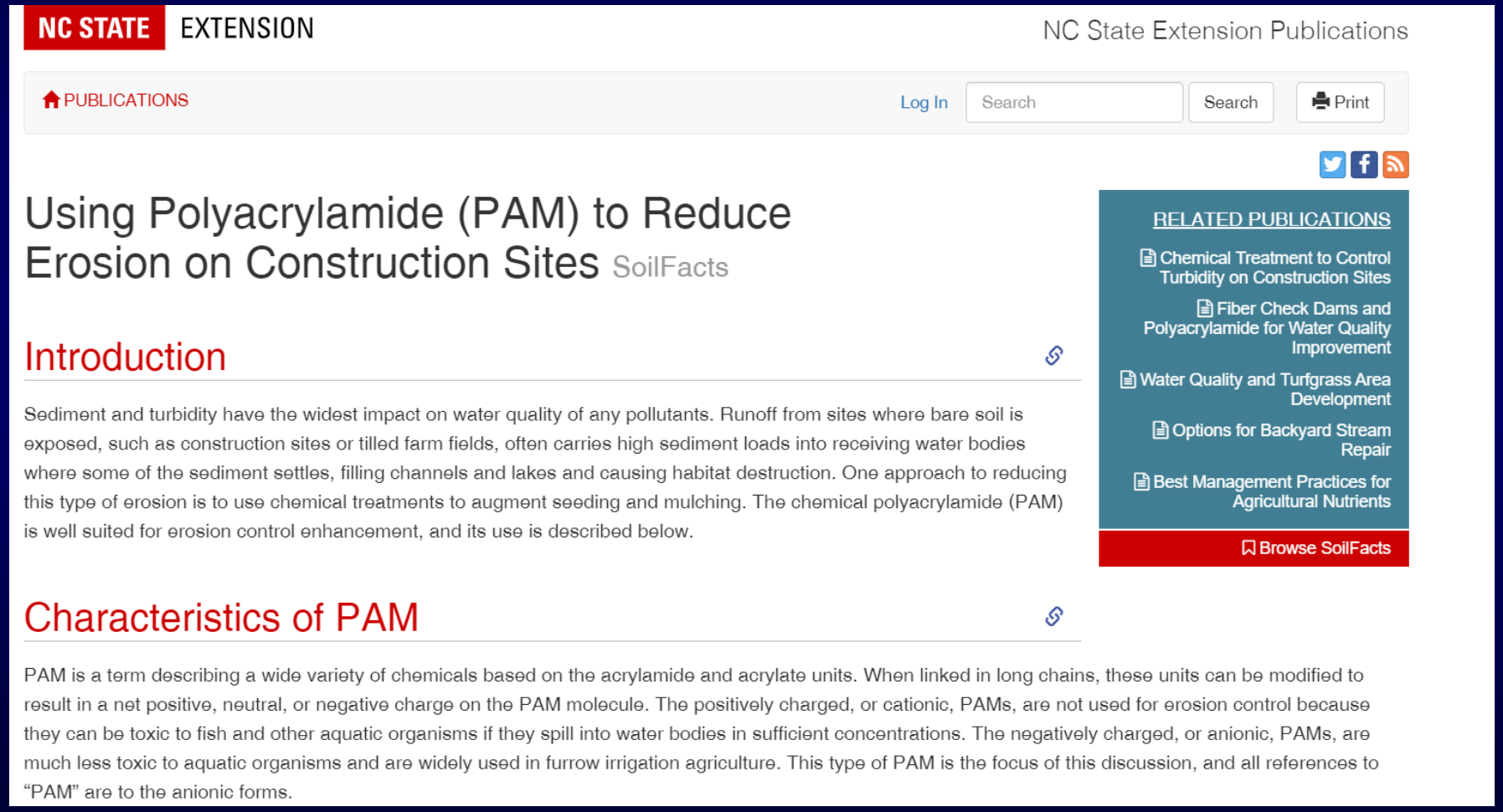
PAM=Polyacrylamide. FGM=flexible growth media. SMM=stabilized mulch matrix. BFM=bonded fiber matrix. WFM=wood fiber mulch. WCB=70:30 wood fiber/cellulose blend.

Summary of Ground Cover Studies

- Not much difference between mulches (straw is fine) for erosion or grass growth
- Applying polyacrylamide reduces erosion
- Weather makes or breaks your grass establishment, especially rainfall patterns. *Supplemental watering recommended!*

PAM for Erosion:

https://content.ces.ncsu.edu/using-polyacrylamide-pam-to-reduce-erosion-on-construction-sites



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Using Polyacrylamide (PAM) to Reduce Erosion on Construction Sites SoilFacts

Introduction

Sediment and turbidity have the widest impact on water quality of any pollutants. Runoff from sites where bare soil is exposed, such as construction sites or tilled farm fields, often carries high sediment loads into receiving water bodies where some of the sediment settles, filling channels and lakes and causing habitat destruction. One approach to reducing this type of erosion is to use chemical treatments to augment seeding and mulching. The chemical polyacrylamide (PAM) is well suited for erosion control enhancement, and its use is described below.

Characteristics of PAM

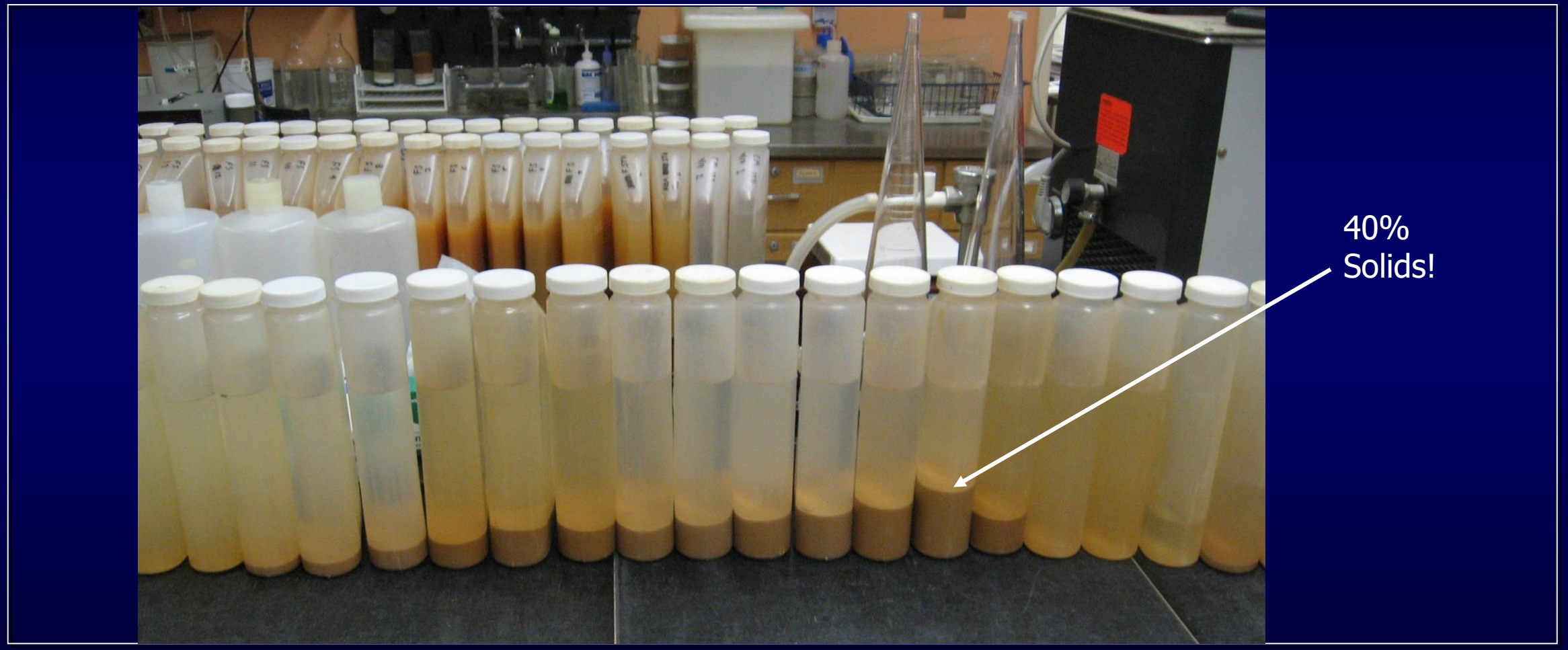
PAM is a term describing a wide variety of chemicals based on the acrylamide and acrylate units. When linked in long chains, these units can be modified to result in a net positive, neutral, or negative charge on the PAM molecule. The positively charged, or cationic, PAMs, are not used for erosion control because they can be toxic to fish and other aquatic organisms if they spill into water bodies in sufficient concentrations. The negatively charged, or anionic, PAMs, are much less toxic to aquatic organisms and are widely used in furrow irrigation agriculture. This type of PAM is the focus of this discussion, and all references to "PAM" are to the anionic forms.

RELATED PUBLICATIONS

- Chemical Treatment to Control Turbidity on Construction Sites
- Fiber Check Dams and Polyacrylamide for Water Quality Improvement
- Water Quality and Turfgrass Area Development
- Options for Backyard Stream Repair
- Best Management Practices for Agricultural Nutrients

Browse SoilFacts

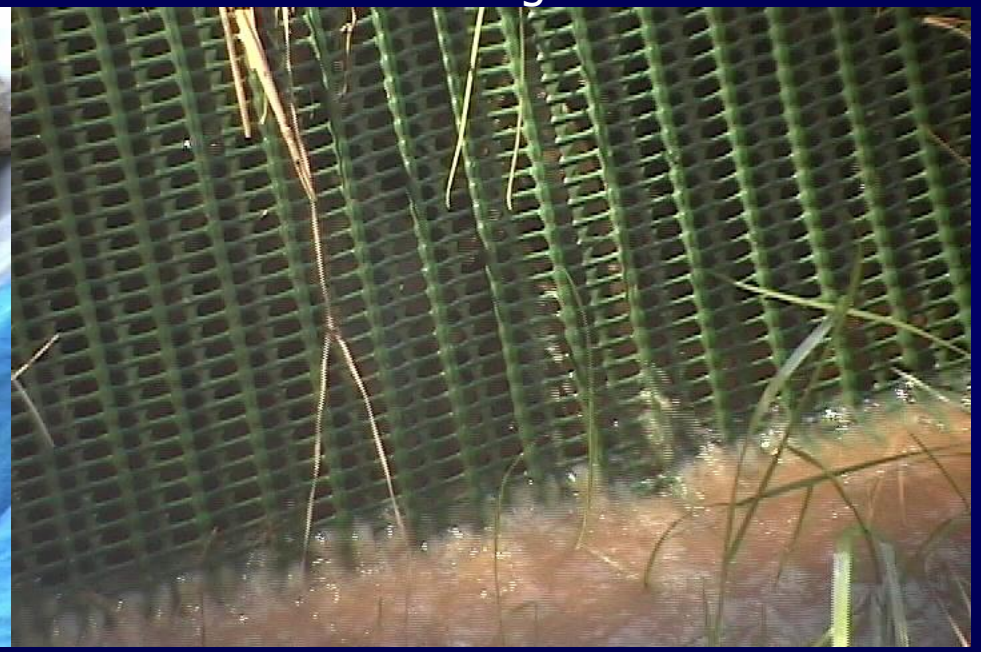
We've Got a Sediment Problem!
Typical Samples from Construction Site



Channel Grade Control: Prevent Ditch Erosion

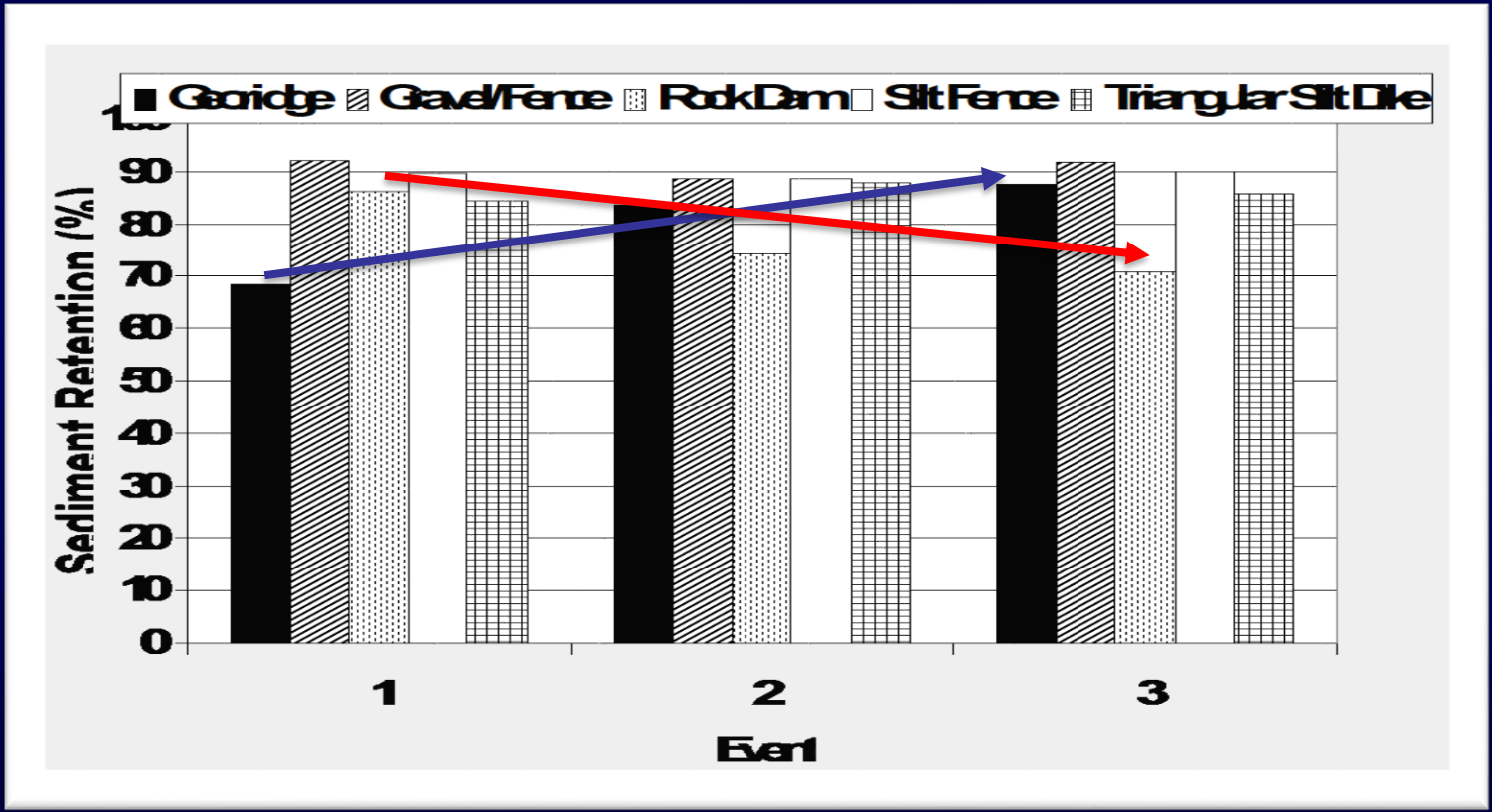
Rock Dam

GeoRidge



Ditches are often the largest source of sediment on construction sites!

Less Porous = Better Grade Control (sediment retention as indicator)

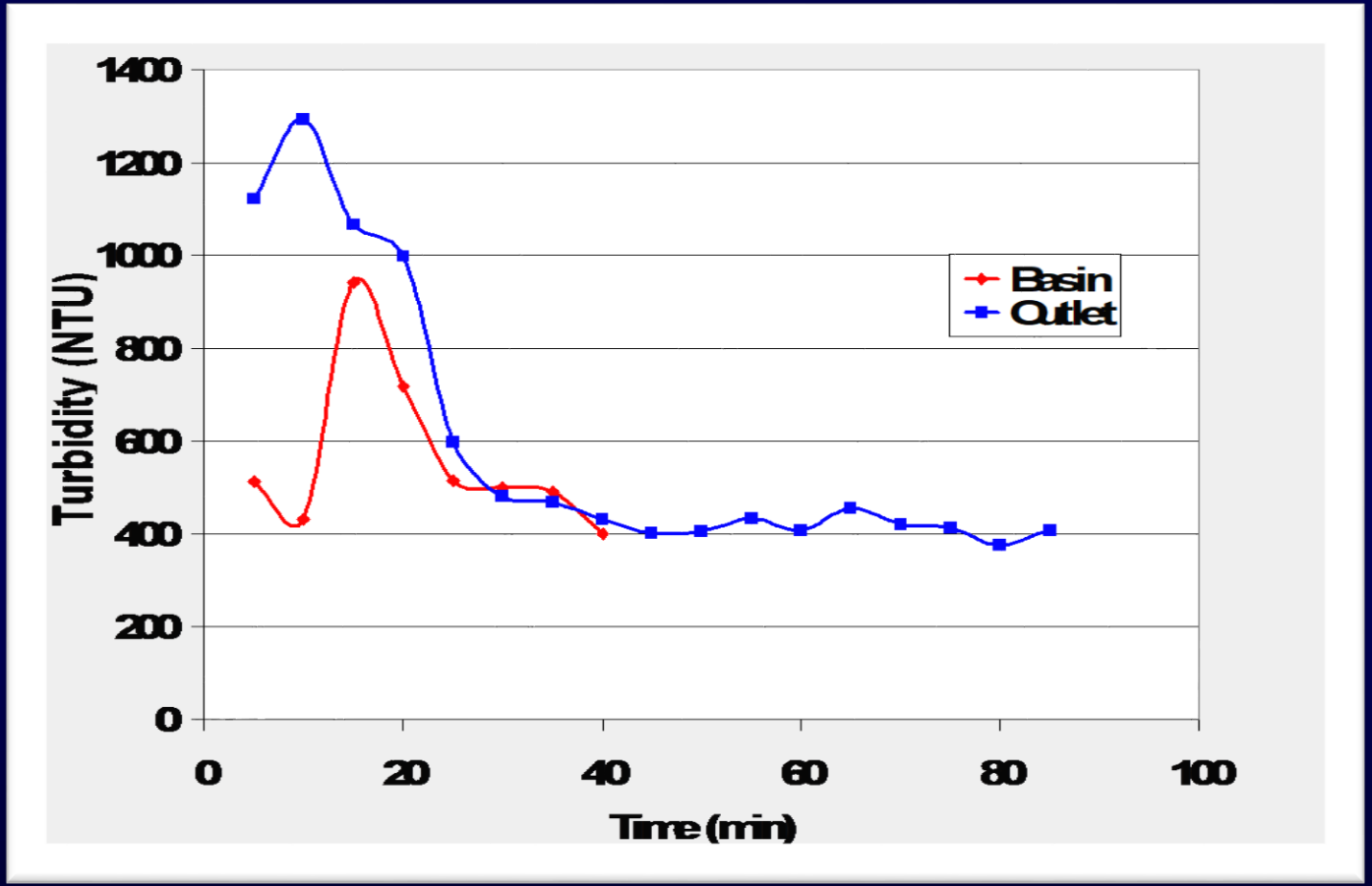


What About Those Sediment Basins?

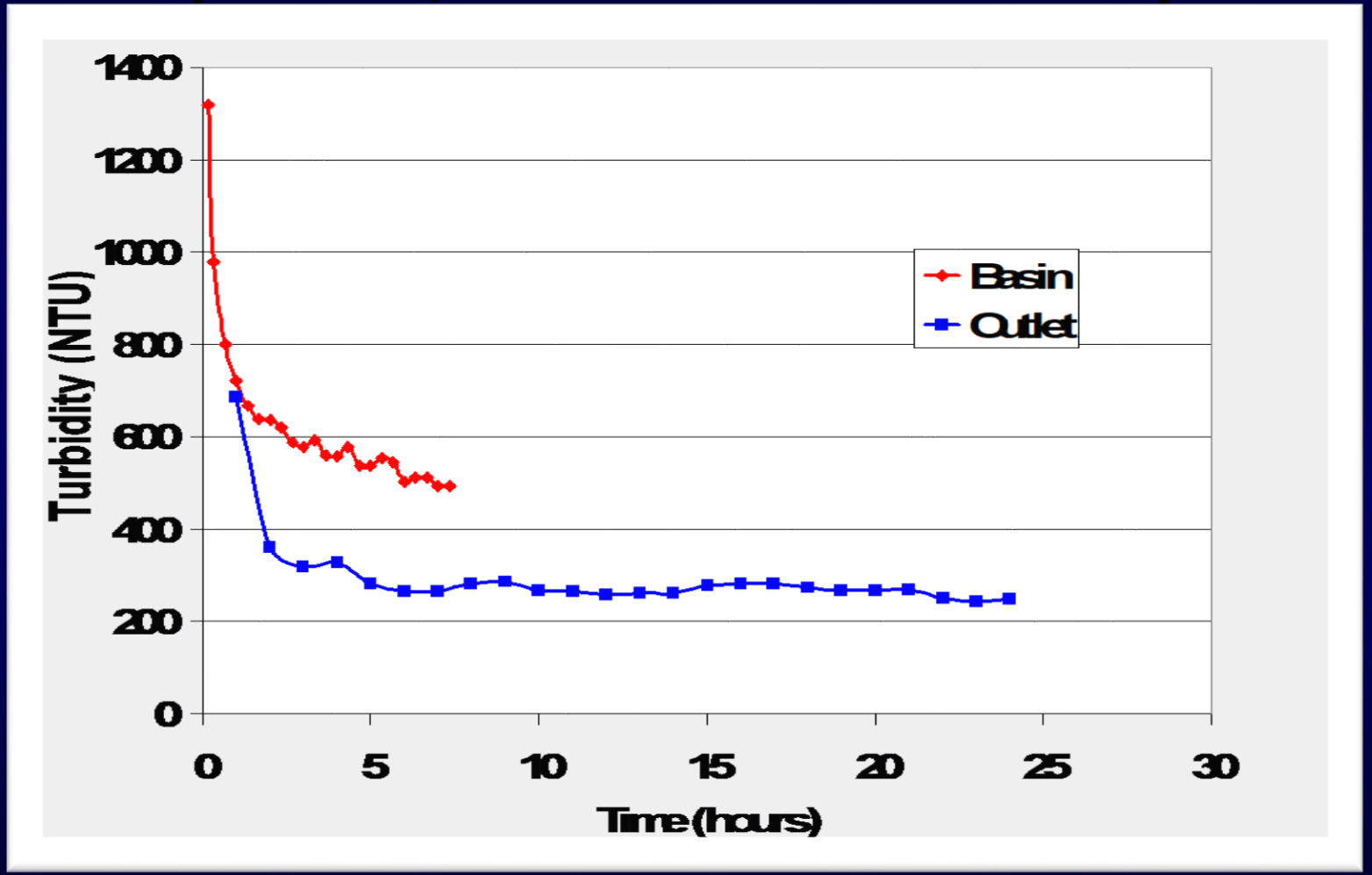
Old Way: Dig hole, rock pile at outlet

Time to do some design testing…

Rock Outlet: 50% Capture, No turbidity change

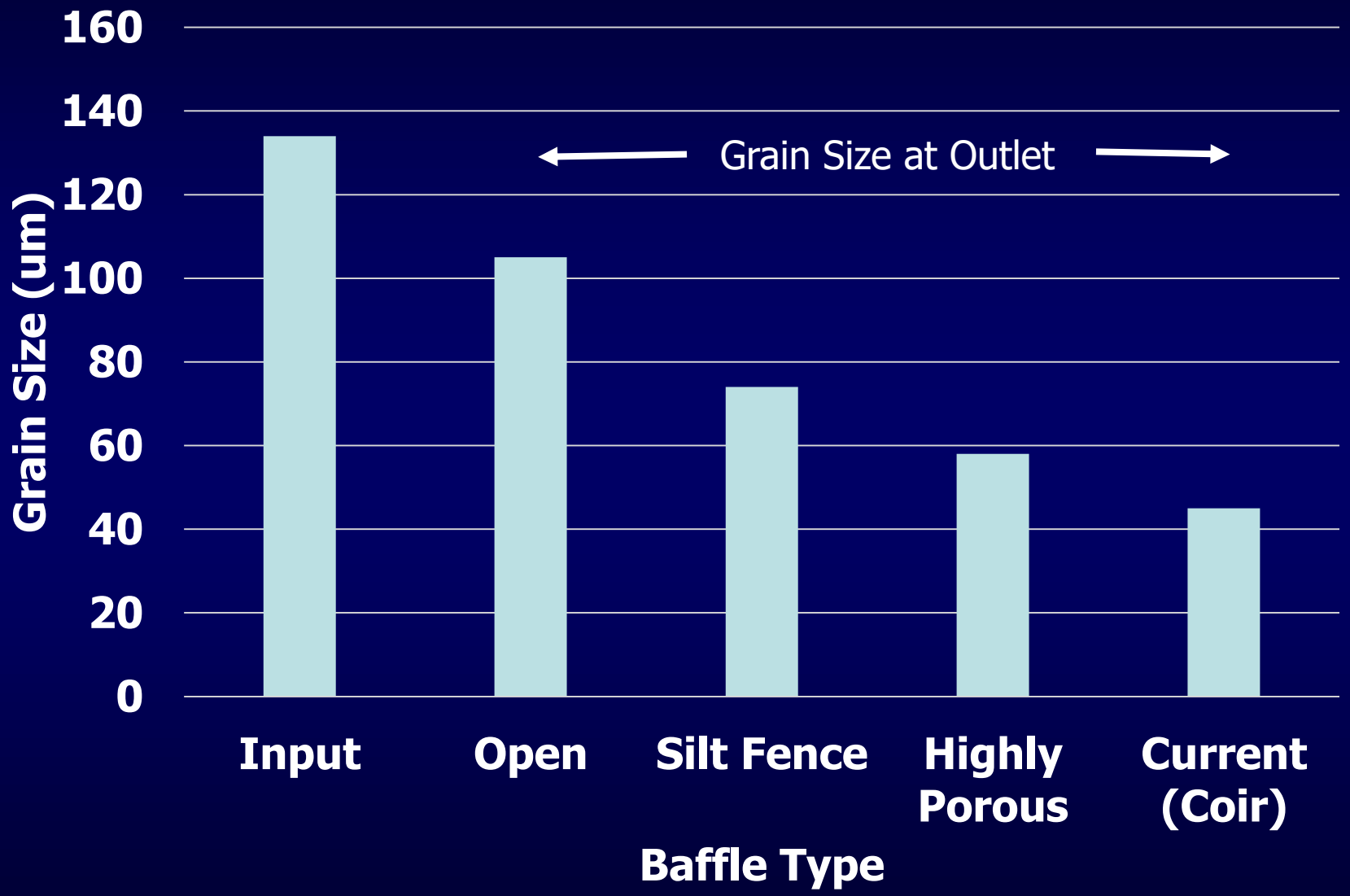


Surface Skimmer Outlet: Higher Sediment Capture, Lower Turbidity



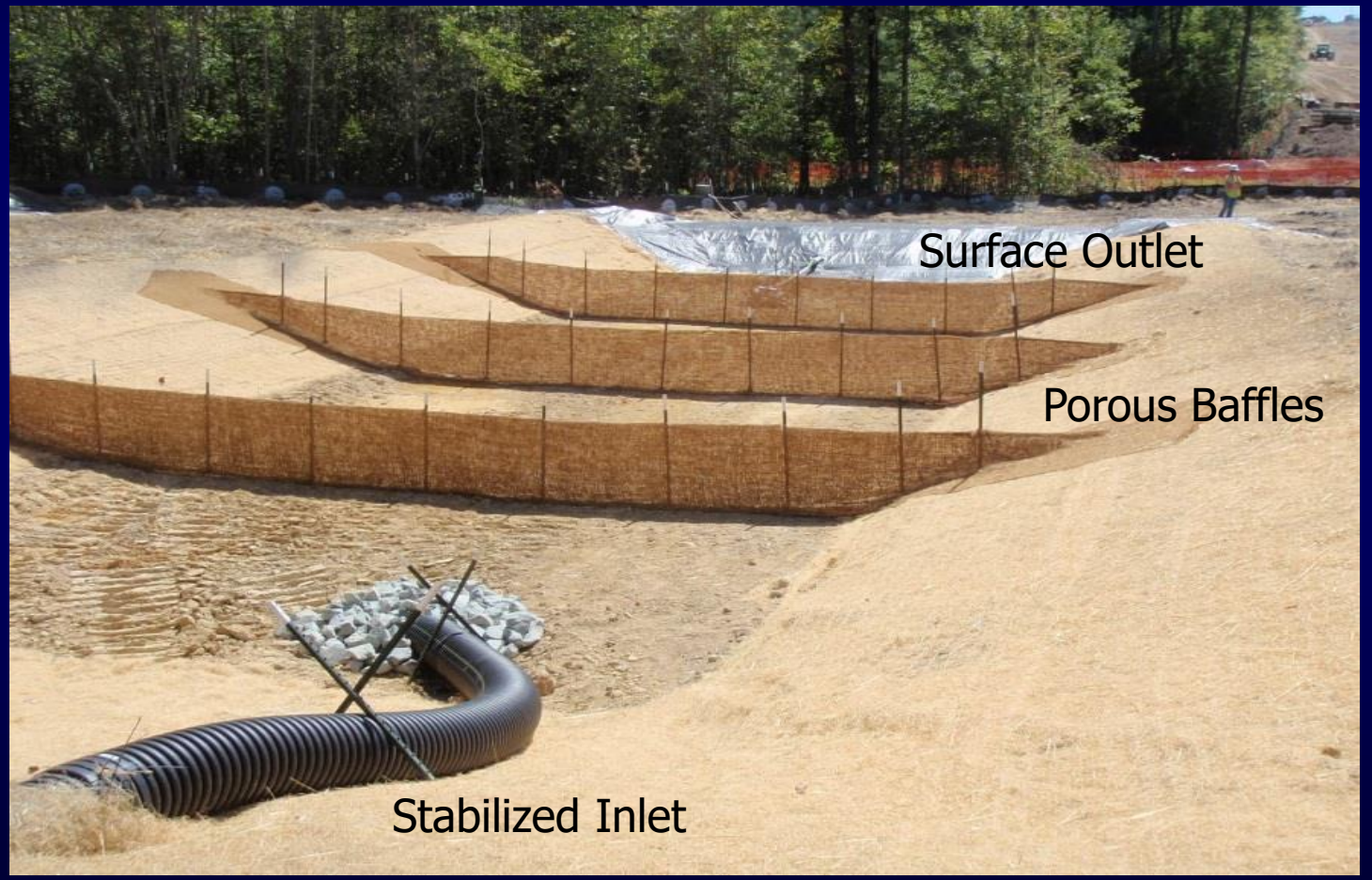
Can We Improve Basin Further: Baffle Testing

Effects of Baffles: Grain Capture Increase



Surface Outlet + Porous Baffles = >90% Capture

Finally: The Optimized Sediment Basin!



Standing Pool: Many Benefits

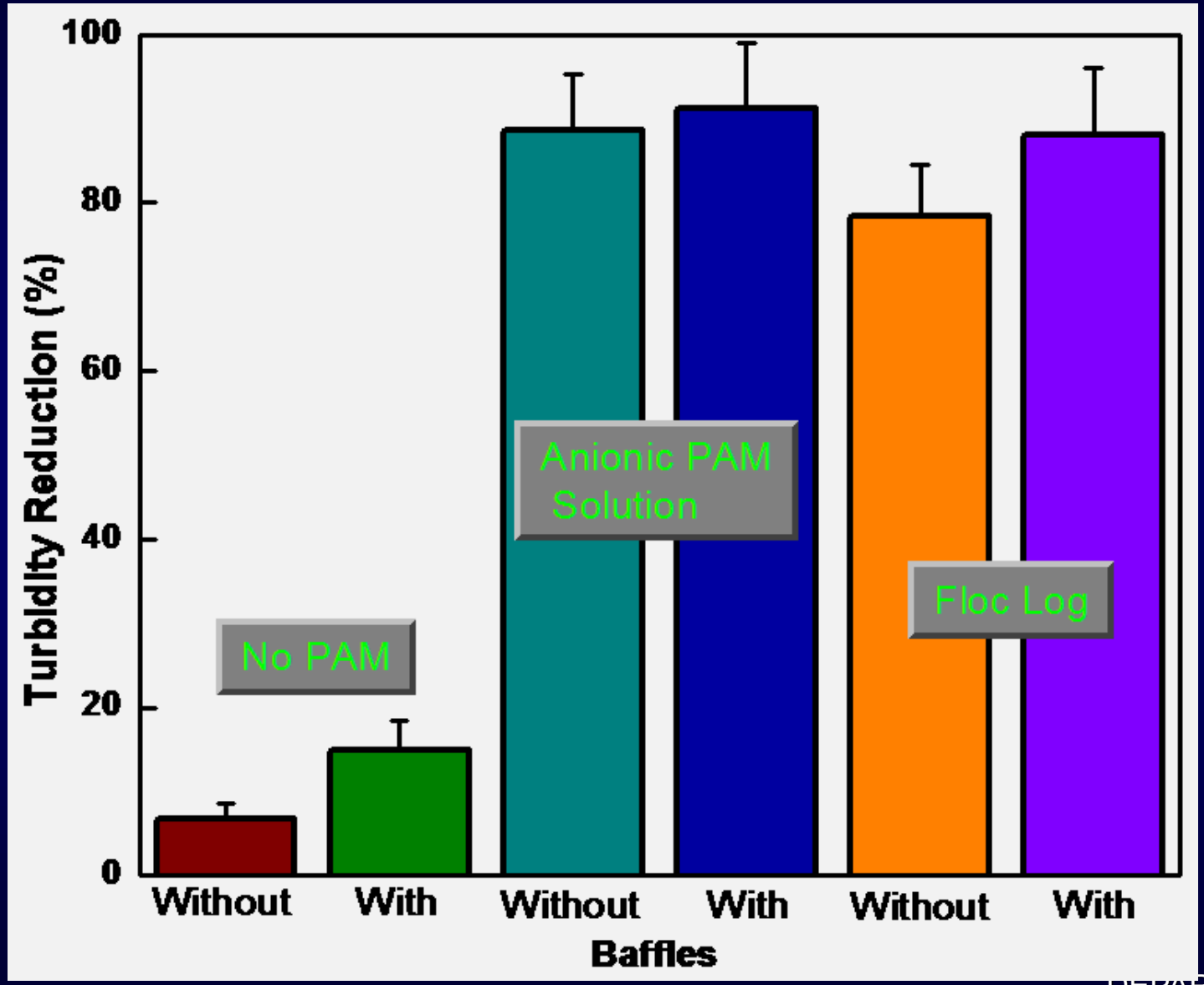
- Keeps skimmer off bottom
- Settles first flush
- Retains "dirtiest" water
- Mosquito issues not likely

Turbidity Still a Problem…

Skimmer Outlet

Basin Design Effects with Flocculants

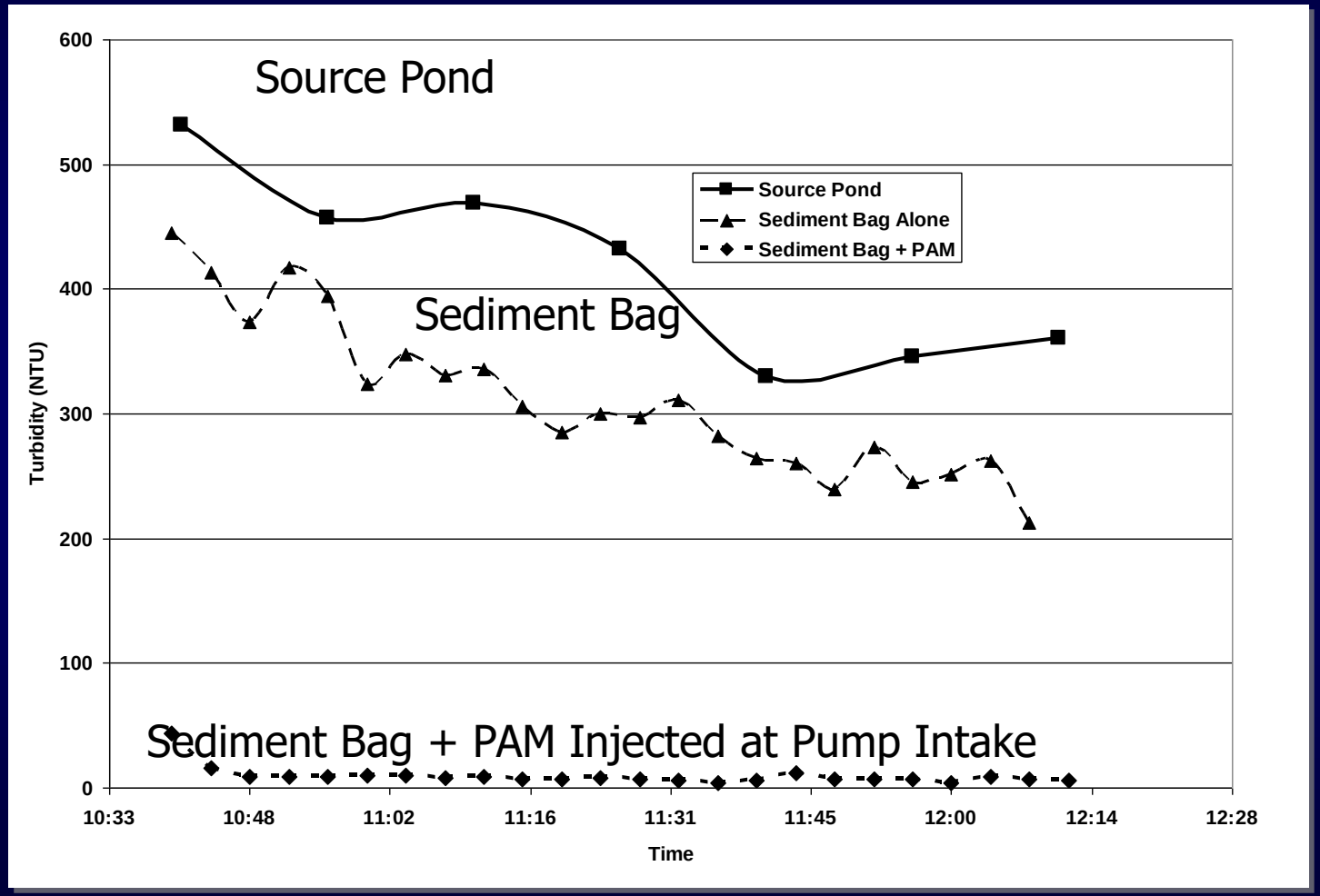
Dosing System: Solution vs. Solid Block



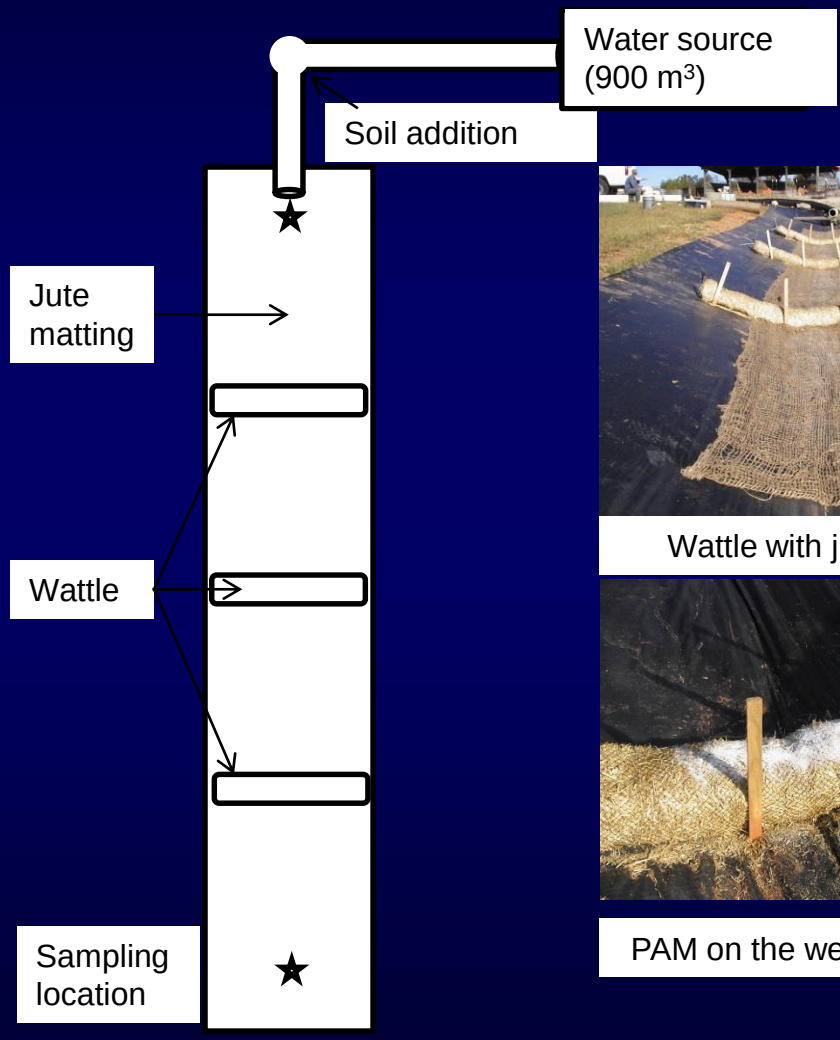
Sediment Bags and Flocculants

Can We Improve Effectiveness?

Sediment Bag and PAM



Testing Flocculation Methods



Wattle with jute matting

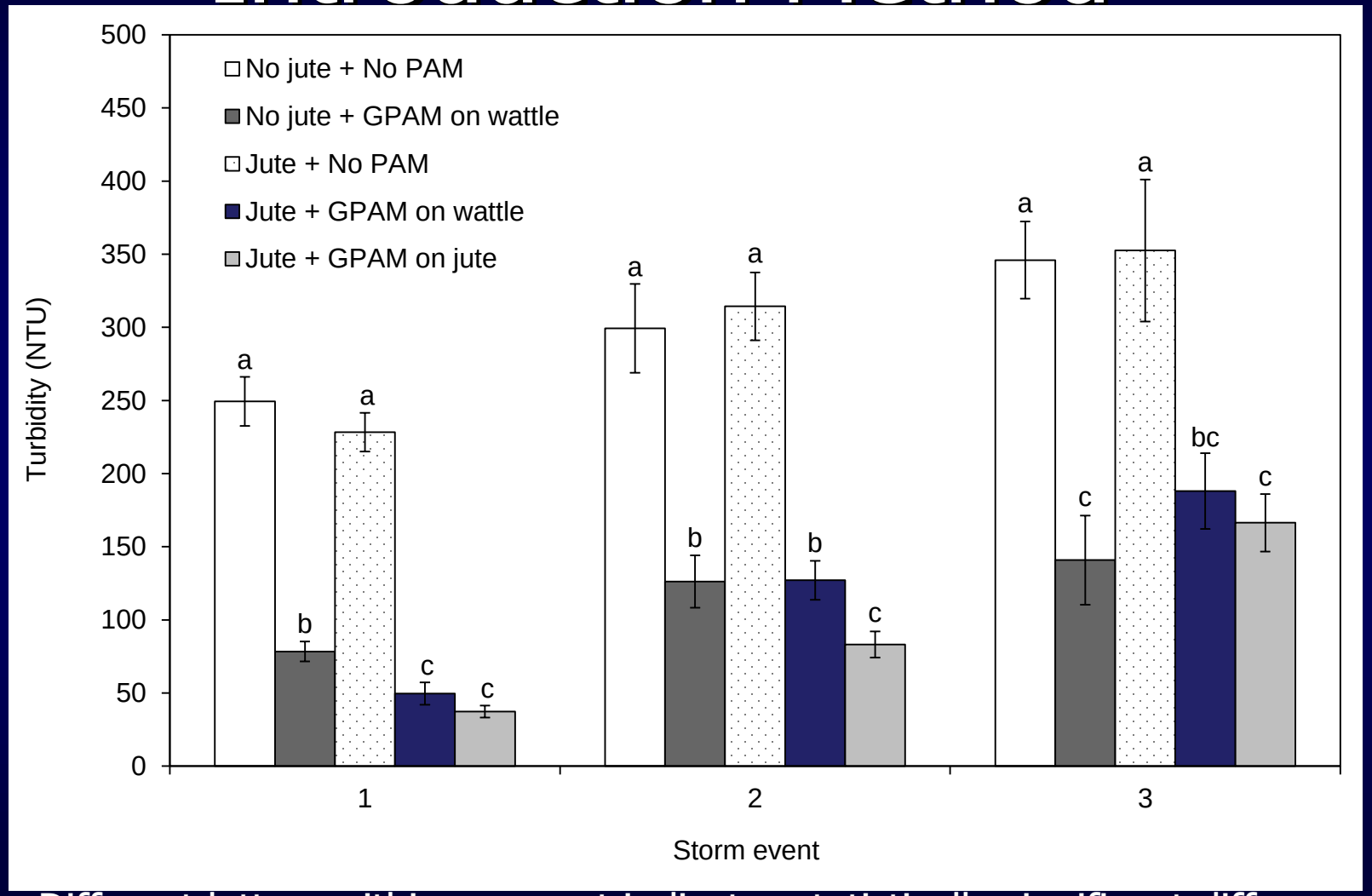
Wattle without jute matting

PAM on the weir of wattle

PAM on jute matting

Flocculant Added

Results: Turbidity Reduction Regardless of Introduction Method



Different letters within an event indicates statistically significant differences

DOT Multi-Chamber Basin to Capture Sediment and Reduce Turbidity

Lower Chamber: Turbidity Reduction

Upper Chamber: Sediment Capture

Installed Turbidity Control

Baffles/Skimmer + Flocculation

- Turbidity reduced 50-90%
- May not achieve regulatory goals (50 NTU), but much better than no flocculation.
- Reduced complaints and impacts.

Successful Construction Site Water Quality Management

- Groundcovers reduce erosion by 90%, PAM will also reduce turbidity in runoff
- Sediment basins with stable inlets and sides, porous baffles, and surface outlets will capture 99% of sediment
- Turbidity can be controlled with proper introduction of flocculants in water conveyance systems

Can we use our developed landscapes for stormwater control?

Without resorting to expensive engineered approaches?

CONTROLLED PLOT TEST ON COMPACTED SOIL

Design:
Randomized split complete block design with four reps

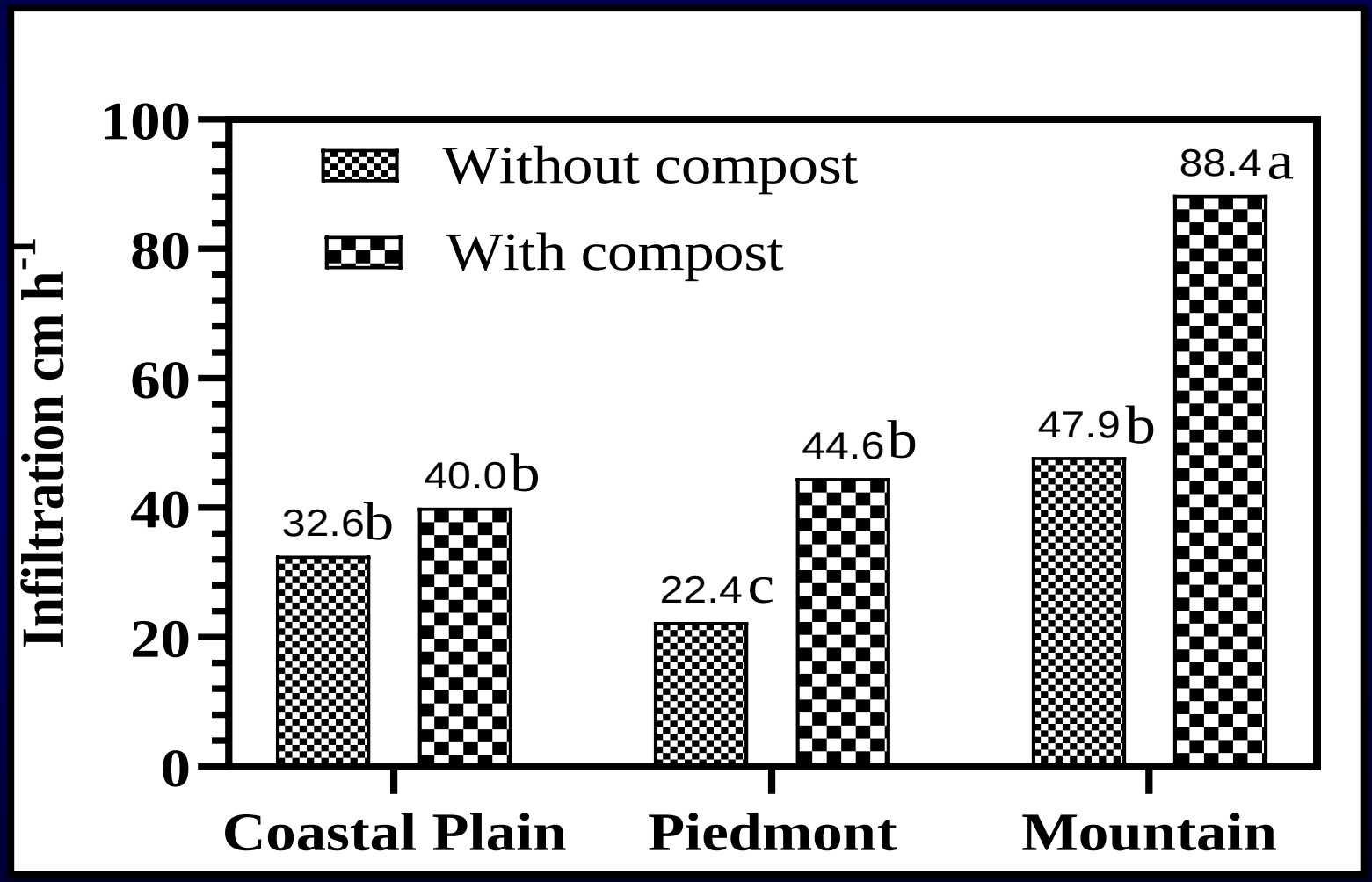
Main plots:
1. Control (C: compacted)
2. Shallow tilled (ST; 15 cm)
3. Shallow tilled+ Lime
4. Deep tilled (DT; 30 cm)
5. Deep tilled+ Lime

Sub plots:
1. Mowed (M)
2. Not mowed

. Fertilizer recommended by North Carolina Department of Agriculture
. North Carolina Department of Transportation recommended mixed seed rate of Hard Fescue, Kentucky Bluegrass and Rye Grass.

Retrofits on Roadsides

Compost Effect at Three Sites: Infiltration



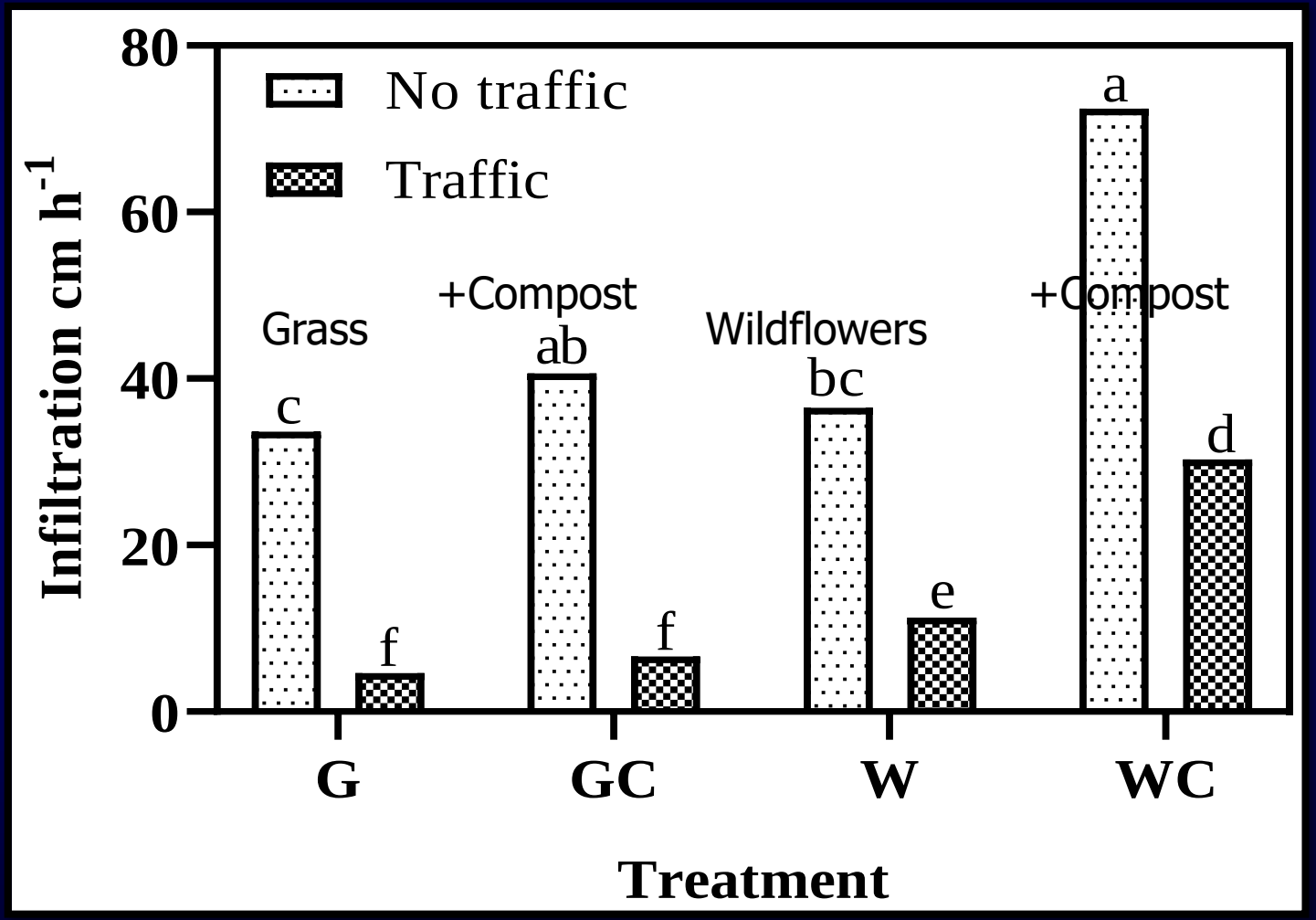
40 cm = 16 inches

Vegetation Effect: Infiltration (cm/hr)

Vegetation	Coastal Plain	Piedmont	Mountain
Grass	26.5b	24.8b	56.3b
Wildflowers	46.6a	42.3a	80.0a

40 cm = 16 inches

Mower Traffic Effect: Infiltration



Wildflower plots were mowed only 1 time each year, grass plots 4X. Less mowing = $$$ saving

Conclusions So Far

- Tillage can greatly enhance infiltration in compacted soils, less effective in long-established grass.
- The effect is long-lasting (we measured up to 3 years) as long as vegetation is vigorous and traffic minimized.
- Compost, at the rate tested, often improved upon the tillage effect and may provide some resilience
- Further testing of compost rate effects is underway.

Unmanned Aerial Vehicles for Construction Site Management

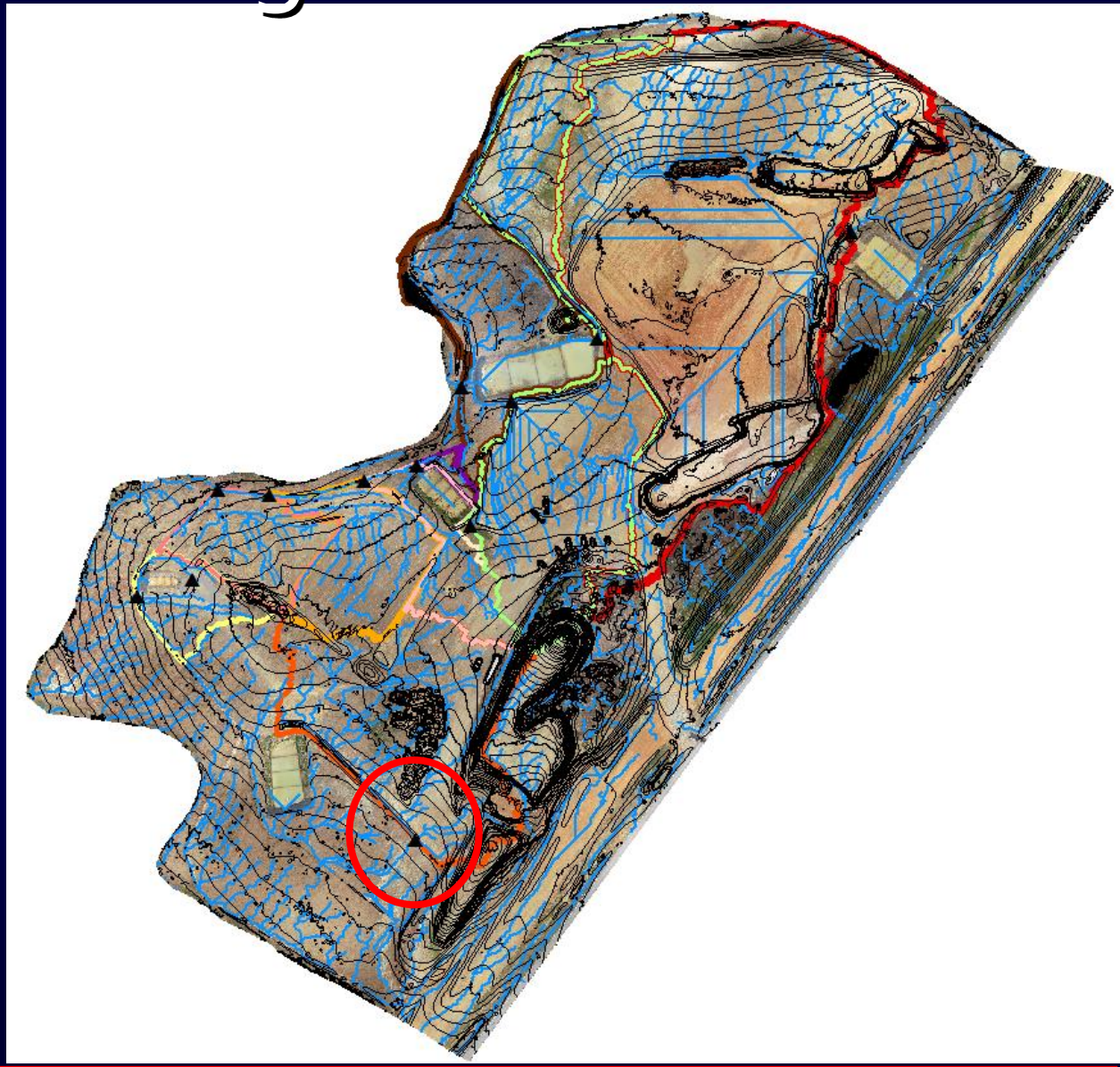
- UAV-based aerial surveys using **Mavic Pro Platinum** and **Phantom 4 RTK** UAVs.
- Can they be used for inspections?
- Can they produce surveys for topographic analyses?

Mavic Pro Platinum flying over the site

Phantom 4 RTK preparing to take flight

Flow Modeling

- Each color is a “watershed”
- Outlets to basins or silt fence outlet



- Breach in berm

Watershed for Each Silt Fence Outlet

Sediment Fence (ha)	1 * (0.2)	2 * (0.2)	3 * (0.2)	4 * (0.1)	5 *(0.1)	6 *(0.3)	7 *(0.2)
Length (m)	59	55	58	41	41	83	50
Date	Estimated Acreage (ha)						
01.28.20	0.08	0.3	0.7	0.3	0.01	0.3	0.0
03.09.20	0.08	0.3	0.8	0.1	0.00	0.6	0.0
03.16.20	0.2	0.3	0.4	0.3	0.04	0.8	0.0
03.23.20	0.2	0.3	0.3	0.4	0.0	0.6	0.0
06.12.20	0.2	0.3	0.01	0.02	0.07	0.08	0.0

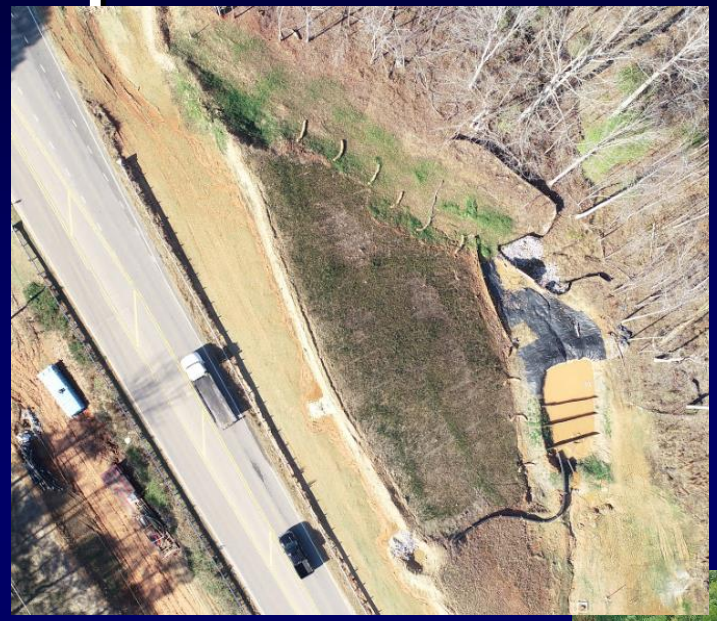
Estimated Excavation from Topography

	UAV Estimates	NCDOT Estimates (truck count)
	Net Changes (m^3)	
Date (Timeframe)	Excavation	Excavation
01.28-20-03.09.20	6390 (597)	4644 (434)
03.09.20-03.16.20	5485 (512)	6028 (563)
03.16.20-03.23.20	980 (92)	719 (67)
03.23.20-06.12.20	27046 (2527)	22064 (2061)
Total Sum	39901 (3728)	33455 (3125)

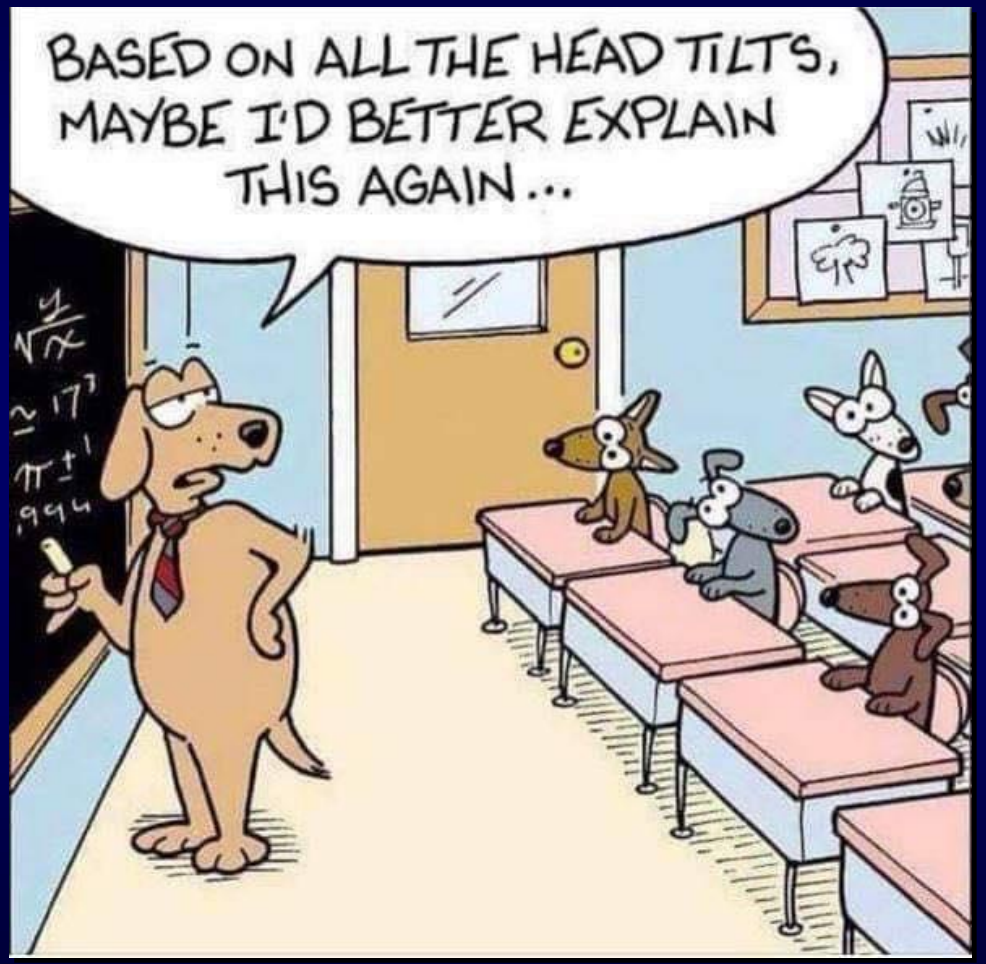
Weekly Inspections

UAV Advantages

- Can work around traffic and equipment safely
- No issues with getting stuck in the mud
- Have a photographic record
- May be faster?
- Silt fences may be a problem



Questions?


BASED ON ALL THE HEAD TILTS, MAYBE I'D BETTER EXPLAIN THIS AGAIN...